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A Methodological Study of Digital E-Memo for RTO (Road Transport Authority) Using Image Rendering

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Abstract: ***Due to the increasing number of road users, it is getting increasingly difficult to recognize each car separately, and manually monitoring the vehicle is becoming more difficult. The fundamental purpose of this study is to provide an effective mechanism for the RTO and the general public to ensure that the Traffic Rule Violence Penalty System runs smoothly. The study endeavours to make the 'Motor Vehicles Act, 1988 - India Code more efficient and accountable. The system developed in the current work can generate the digital memo by Number Plate Scanning. This will improve penalty collection accuracy while also storing offender data for future applications. The application was created for the Traffic Police Department, and the website was created for Indian citizens. In addition, the study involved consulting Subject Matter Experts and Traffic Police Departments to determine the work's feasibility and adaptability.***
Keywords: Number plate scanning; Traffic; Vehicles; Motor vehicle rules.

I. INTRODUCTION

Vehicles are an important component of the traffic control system. It causes significant difficulty for the traffic control area in terms of managing this big volume of traffic. This is owing to the rapid growth of the population, which makes it difficult to control car traffic at this time. Due to the growing number of users on the road, it is becoming increasingly impossible to recognise each car individually, and manually monitoring the vehicle is becoming increasingly difficult. For this reason, ANPR becomes a critical component of a fast-cognitive transportation system. Furthermore, in the current context, application complexity is increasing, necessitating higher requirements for an effective licence plate recognition protocol [1, 2].

An "Automated Number Plate Recognition (ANPR)" system is essential for effective road monitoring and management. ANPR employs image processing methods that aid in the detection of vehicle licence plates and the recognition of number plate characters. An ANPR system aids in the capture of the vehicle possessor record by identifying their car plates in perfunctory surveillance of pedestrians or vehicle management [3, 4]. Because ANPR is a bulk surveillance method, it plays a vital part in traffic management protocols by simply recognising licence plates. The photographs are taken with a camera and the vehicle's owner is recognised using number plate recognition technologies. The basic working procedure of ANPR is shown in Figure 1 [5].

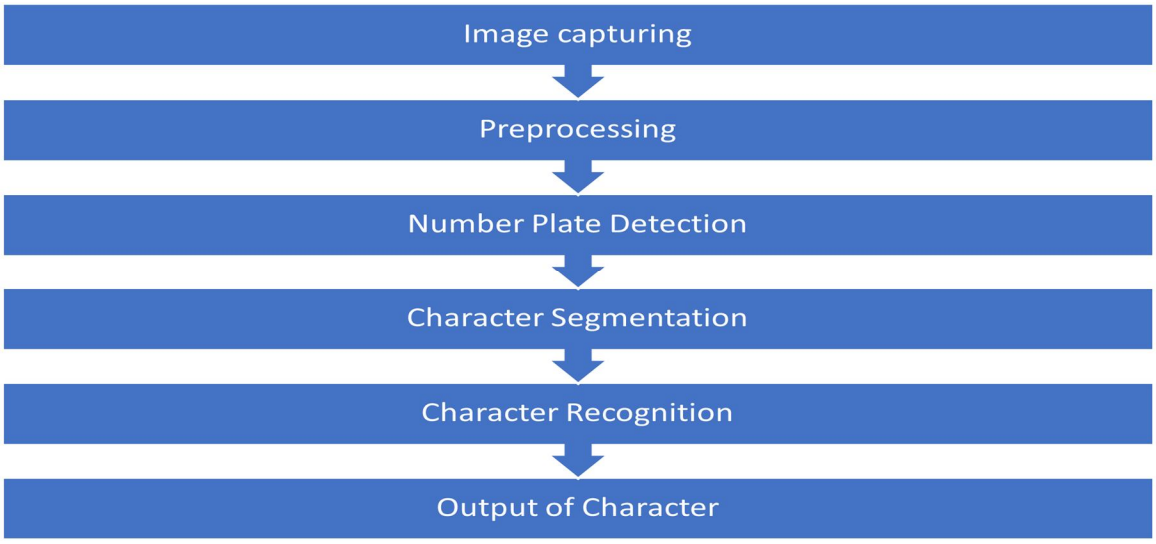


Figure 1: Basic structure of ANPR

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The very first ANPR system was developed by the "Police Scientific Development Branch" in Great Britain in 1976. Even though its primary prototype system began working after 1979 when contracts for manufacturing in industries were awarded. It began its career at EMI, Electronics, and was later transferred to Computer Recognition Systems (CRS) in Wokingham, UK [6].

In the present study, the system is prepared for the smooth functioning of the Traffic Rule Violence Penalty System by automatic number plate scanning and generating E-memo. The current system was developed considering the problems such as manual handwriting which is a time-consuming process, proof of penalty is insufficient, Ease of manipulation and a large amount of paperwork, Useless records, and Lack of Transparency, Efficiency, And Accountability.

II. LITERATURE REVIEW

There have been many studies performed by researchers and academia on automatic and semi-automatic systems to maintain and proper functioning traffic and traffic rules. Some of them are explained in the current section. The authors presented “Automatic penalty charging for violation of traffic rules” which offered a cutting-edge technical solution for bettering traffic control. For violations of traffic rules, the system presented in this study automatically imposes a penalty on the car driver. If a car is stopped on a zebra crossing when the signal is red, if it has passed the speed limit zone, or parked in an area where there is no parking zone if a signal has been crossed unlawfully, or if the PUC has expired, the penalty will be charged to the car owner automatically [7]. The article proposes an Android application to assist traffic cops in keeping track of penalties in a centralised database. The application also has a section for reviewing traffic offences, which allows higher authorities to take appropriate traffic enforcement steps. All of the work in the existing challan system is done manually, which takes a long time, and traffic cops must keep challan books up to date. Additionally, the police may issue the car owner with a phoney challan, which leads to corruption. As a result, this project aimed to reduce challan corruption as well as the time it took to prepare the challan [8].

This [9] article presented a vehicle document check system in which traffic cops' smartphones fetch databases and documents. Initially, the authors of this system issued the car owner unique identity numbers and scanned and saved their documents in a database at the back end, from which a QR code was formed and attached to the vehicle. The application was created so that after scanning the QR Code, the vehicle owner's information and the papers scanned previously could be accessed from the database. If the scanner fails, the writers have created a unique identifying system based on the driver's licence. This work also included an attempt to use an alert to locate the stolen vehicle.

The main focus of the study [10] was on the fundamentals of QR codes, their applicability in everyday life, and research fields related to them. The structural versatility of the QR Code has spawned a plethora of study topics, including data capacity and security applications. This paper describes several studies that were carried out to improve the recognition of QR Code images, including scratch removal techniques. As a result, the purpose of this study was to emphasise the research areas surrounding the QR Code. The study [11] proposes QR Codes to solve the challenges connected with ANPR "(Automatic Number Plate Recognition System)". The ANPR technique reads vehicle number plates using OCR on photographs. However, it has several drawbacks, including misidentification and foggy number plate photos that fail to identify the vehicle. As a result, this study proposes a quick response code, which is a two-dimensional bar code that allows for easy access to information via smartphones and has various advantages over ANPR.

With the use of image processing, this research [12] developed a system to control traffic on the road. The traditional traffic control system and its disadvantages have been explored in this study. The technology takes a picture of the road where traffic must be regulated. The image will then be transformed to greyscale and then black and white using an algorithm, and the acquired image will be compared against an image of an empty road, with the density of traffic on the road being recognised using edge detection techniques. The article [13] proposes a sophisticated monitoring system to keep track of vehicles that have broken traffic laws. At the moment of the occurrence, the system will create detailed data, which will be sent to the RTO office, where the officer can take further action. This was an attempt to manually identify the offending vehicle, which is quite tough. As a result, this system has been proposed.

Due to characteristics such as "high security, reliable secure transfer of information, ease of implementation, and ease of use, QR-based authentication" is currently relatively prevalent and widely used, according to this article [14]. The data is kept in an encrypted manner. A QR Code is a two-dimensional picture that encodes digital data. Also, even if the code is partially destroyed, it may be read, and the data is not lost. Its key characteristic is its adaptability, which has helped it become popular because these can readily be scanned using camera-based mobile systems. As a result, it can run on any hardware platform. This work [15] offered a unified and separate approach (algorithm) for recognising a specific section of an image based on the user's needs.

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This method can be used to figure out or cast out a car number plate or an entire vehicle image taken through a camera. Also, once the key required objects have been identified and removed from the image, other unnecessary data can be discarded, resulting in a reduction in the amount of data that has to be stored in an urban surveillance system.

This study proposed a system that would automatically impose penalties on traffic rule violators who broke the rules. There are three units in this system. The first was a standalone system that would be connected to the vehicle's ignition mechanism, the second was a standalone system that would be connected to traffic signal points, and the final was a mainframe RTO unit. For the automobile to start, the driver must place his RFID driver's licence card close to the reader. This was an attempt to reduce the city's "corruption, pollution, bribery, and traffic congestion" [16].

Using image processing, the author [17] created a method for estimating traffic. This is accomplished by converting movies and camera photos from the highway into image sequences. The number of cars has been counted after each image has been analysed independently. A notice of heavy traffic will automatically be displayed if the number of automobiles surpasses a certain level. Initially, a camera records a lane on film, and pictures are shot. The traffic density is then determined by efficiently processing these photos. The controller will instruct the traffic LEDs to display a specific time on the signal to manage traffic based on the MATLAB-processed data.

The study [18] produced a sophisticated traffic management system. Where an RFID tag is installed on each car. The car will signal the RFID reader when it is within range of the RFID reader. The RFID reader will count the number of vehicles that have passed through during a specified time period in order to calculate the volume of congestion. RFID systems are susceptible to disruption. RFID systems are comparatively simple to jam utilising energy at the appropriate frequency because they operate in the electromagnetic spectrum, just like Wi-Fi networks or cell phones.

The study [19] suggested a novel method for extracting video objects from a sequence using background subtraction techniques. The technique relies on a virtual 3D model of the background that is automatically built and updated using a series of photos of the environment rather than working with a fixed, flat background. When an image is taken, the camera's location is inferred, and the corresponding view of the background can then be produced. Video items that aren't in the backdrop are provided by subtracting the frame from the view. Over 20 frames per second in real situations, the system operates as intended. Our background update mechanism allows it to recover from variations in lighting and automatic white balance (AWB).

Using the removal shadow approach in RGB colour space and frame difference technique, the author [20] created a method for detecting moving vehicles. To eliminate shadow, the brightness and chrominance values in RGB colour space are adjusted. The outcome demonstrates that 75% of the shadow may be eliminated during picture-moving object detection.

III. METHODOLOGY AND RESULT

Traffic laws can greatly reduce the number of accidents on the road. Providing lawbreakers with punishment and legal repercussions is an effective technique to make individuals recognize their mistakes and become aware of them. A few traffic violations law and fines in India are listed in table 1 [21, 22].

Table 1: Indian Traffic violation laws and fines

Traffic rules violated	Fine amount
Drunk driving or driving under influence of intoxicated items	Rs.10,000 and/or 6 months in prison, Rs.15,000 and/or 2 years in prison in case of repetition of the violation
Overloading pillion riders	Rs.2,000 plus disqualification of licence and/or community service for three months
Over speeding	Rs.1,000 for LMV, Rs.2,000 for MMV
Dangerous driving	Rs.1,000 to Rs.5,000, licence seizure, and/or 6 months to 1 year in prison
Driving without licence	Rs.5,000 and/or community service
Driving without insurance	Rs.2,000 and/or 3 months in prison, community service, Rs.4,000 in case of repetition of the violation
Signal jumping	Rs.1,000 to Rs.5,000, licence seizure, and/or 6 months to 1 year in prison
Riding without helmet	Rs.1,000 plus licence scrapping for three months
Riding without permit	Up to Rs.10,000
Juvenile driving	Rs.25,000 with three years of imprisonment, cancellation of registration of the vehicle for 1 year, and ineligibility to avail a driving licence until 25 years of age

The present study aims to automate the process of traffic laws by scanning the number plate automatically through image rendering technology. An application is made which scans the number plate and automatically generated the digital memo also known as an e-memo. The methodology of the process is explained in the flowchart represented in figure 2. Whereas the technology used in the study i.e. number plate localization process is explained in figure 3.

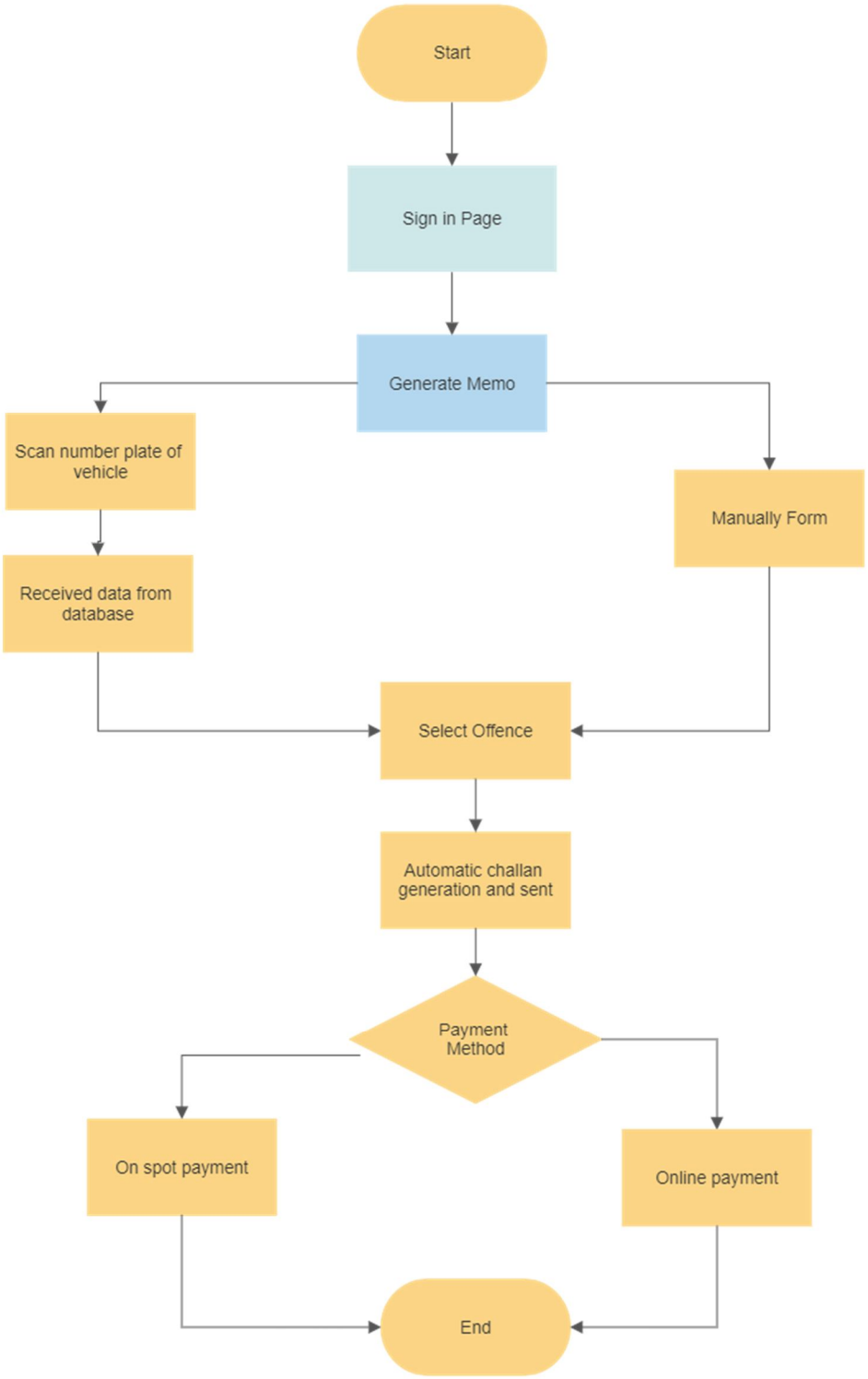


Figure 2: Flowchart of Methodology

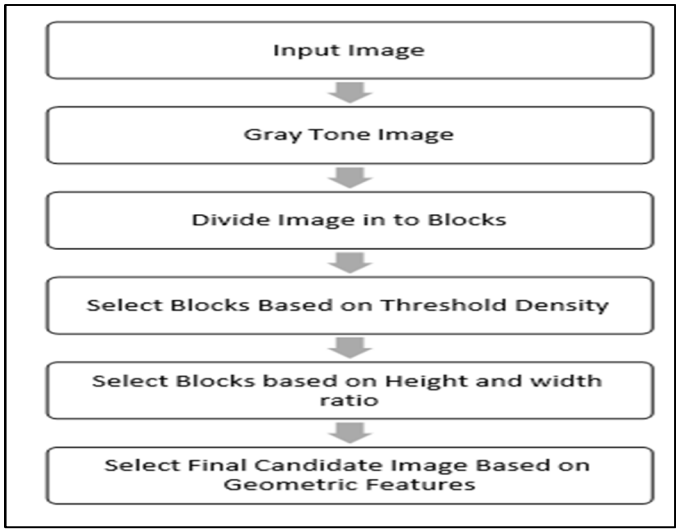


Figure 3: Number Plate Localization Process

The tools and technologies used in the present work included Flutter 2.2.3, NodeJS 14.17.6, AWS Rekognition, MS SQL 15.0 (SQL Server 2019), M OpenCV 4.5.3, and MongoDB Atlas Cloud. For text recognition, the OCR technology was utilized. The term OCR refers to Optical Character Recognition. It is a type of technology that can identify text in digital images. Text in scanned documents and photos is frequently recognized using this technique. A real paper document or an image can be transformed into a text-rich, searchable electronic version using OCR software. By finding and identifying characters, such as letters, numbers, and symbols, OCR software processes a digital image. Other OCR applications can transform the characters into editable text right in the image, while some merely export the text. The text on a page can be exported with its size, formatting, and page layout thanks to advanced OCR software.

The application was successfully developed. In addition, the interface such as Home Page UI Transitions, Login Pages, Dashboards, Memo Transaction History, User Profile, Number Plate Scanner, Enter Vehicle Plate Number, Enter Memo Details, and Generated Challan. Moreover, the snapshots of the application's interface are demonstrated in Figures 4 and 5. The "User Profile" shows the police officer's system-generated profile. There is a number plate scanning option on the "home page". The camera will open by clicking over it. The number plate text will be recognized by Google's OCR. The "Enter vehicle number plate" interface requests that the database be searched for the offender's information. The "Enter Memo Details" interface allows officers to input more pertinent information, such as the address, phone number, and email, before selecting the designated infraction from a list. It displays the car owner's information first. Further, after providing the necessary challan information, a confirmation question will appear before the memo is properly sent to the provided email address, mobile phone number, and address using the "Generated Challan" interface. The police officer can view all of the challans he previously generated by selecting "Memo transaction history" from the application's transaction history. By using this method, users and offenders can go to our website to pay the challan and settle their debts. To clear the outstanding amount, offenders can also pay a police officer in cash or online.

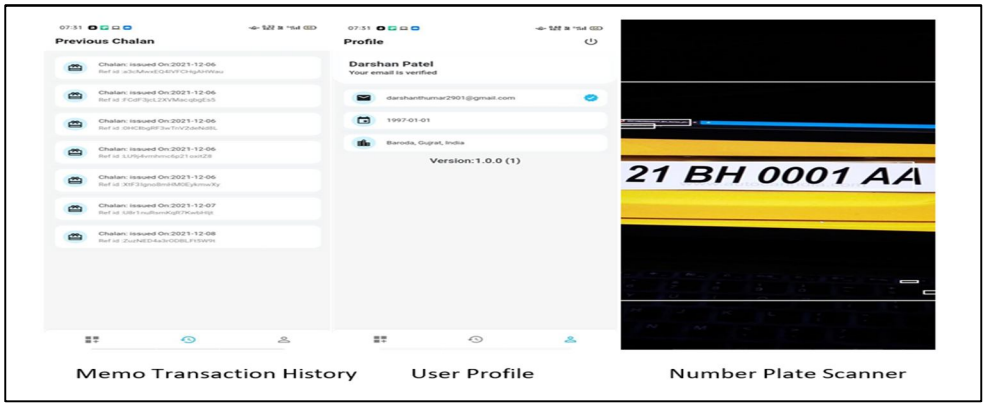


Figure 4: Application Interface

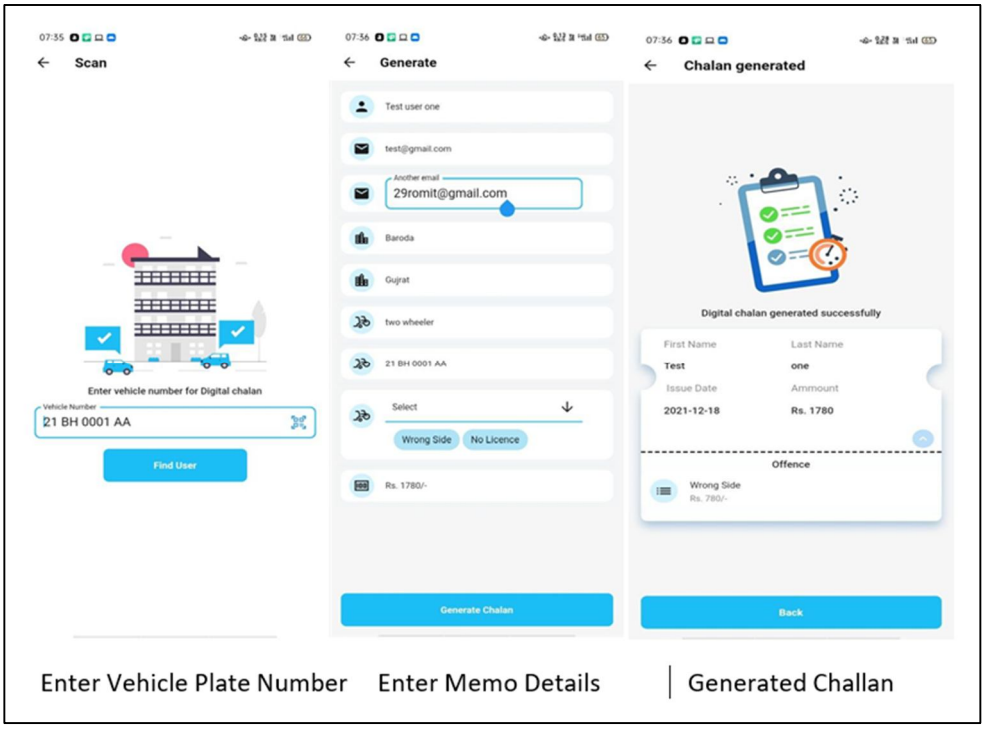


Figure 5: Application Interface

IV. CONCLUSION

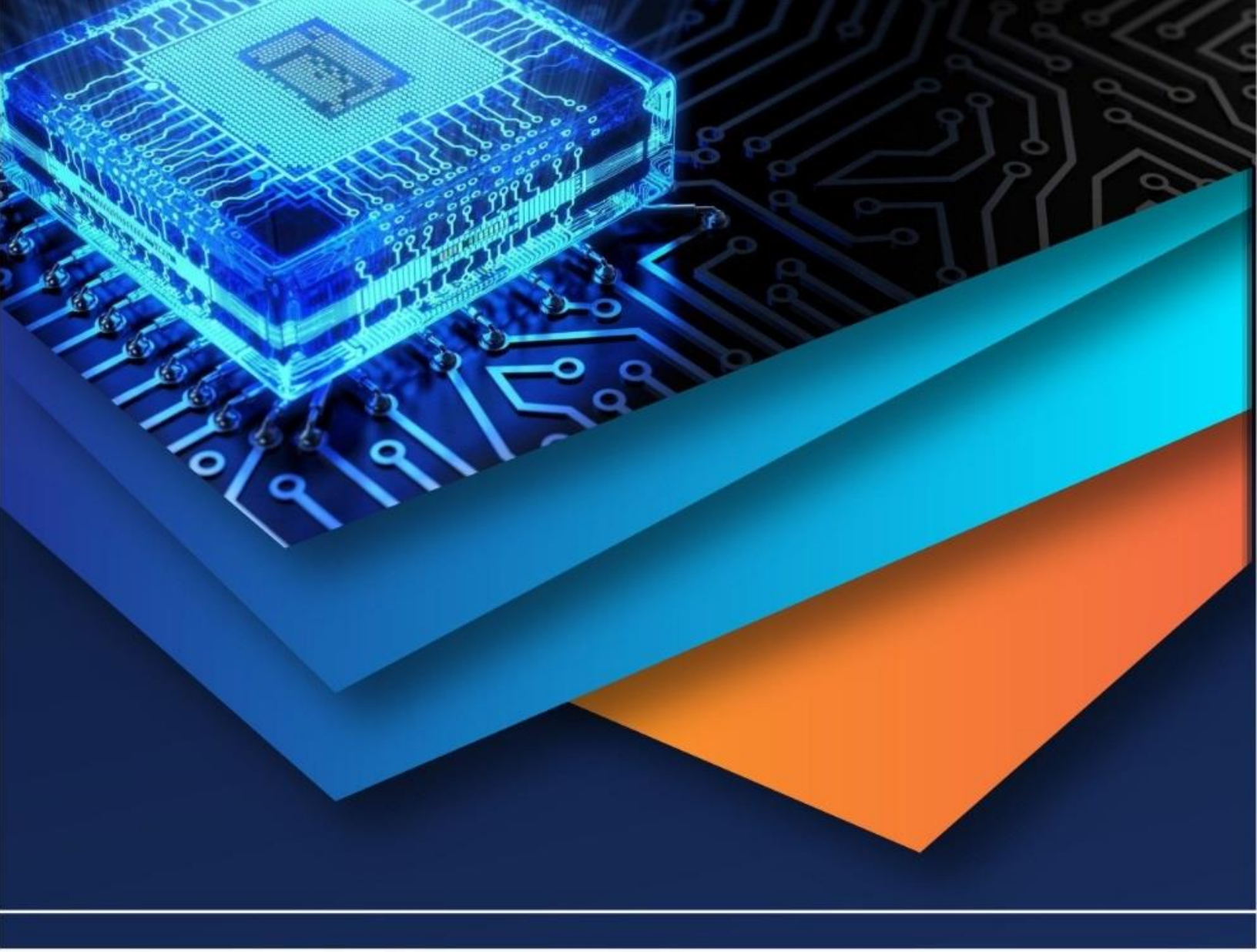
The author of the article has successfully produced an application that is ready for live deployment and can be used as an official penalty collection platform by implementing it at the national level after consulting Subject Matter Experts and Traffic Police Departments to determine the work's feasibility and adaptability. This will improve penalty collection accuracy while also storing offender data for future applications. It has the potential to replace the present manual and POS-based challan creation mechanism. It can also work together on data-driven studies and policy reforms. The application could be used to scan the number plate through the image rendering process and can generate the memo and challan automatically. The present system will provide the faulters to pay online or offline on the spot. This will greatly reduce human effort by implementing this modern technology.

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